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Observations on purse-seined king mackerel

(Scomberomorus cavalla) and Spanish mackerel

(Scomberomorus maculatus), March 1983-March 1986

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INTRODUCTION

Concerns about over exploitation of fishery resources by purse seines were raised by Moe in 1967. His warnings followed Ingle's (1967) report on experimental purse seining supervised by Florida's Board of Conservation between 1964 and 1967. Approximately 100,000 pounds of king mackerel were caught in the winter of 1965-66, and about 44,000 pounds were caught the following winter with purse seines. Ingle concluded that purse seining was feasible and that it was quicker, more efficient, and the equipment was easier to use than a gill net, but that it had limitations in use over rough bottom. Moe warned that unregulated exploitation with purse seines could result in the depletion of Florida's fish stocks and the ultimate loss of valuable fisheries.

Similar concerns were expressed during the development of the Fishery Management Plan for Coastal Migratory Pelagic Resources by members of the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council. Thus, when the plan was implemented in February 1983, it required that for three years, observers be placed on any purse seine vessel fishing for king mackerel or Spanish mackerel. The plan stated, "There are two main reasons why observers are necessary: (1) to accurately count the total harvest and (2) to obtain an accurate and unbiased report on purse seine activities."

This report summarizes the observations made, and data collected on fishing activities, species in the catches, and size and sex composition of mackerels, while aboard purse seine vessels from March 1983 through March 1986.

PURSE SEINE OPERATIONS, TRIPS, OBSERVATIONS, AND CATCHES

As one might expect, variation in purse seining gear and methods are common. The purse seine vessels on which the observers served were 60-75 feet long, but varied in their use of a drum to store their net aboard the vessel, and their use of the services of a spotter plane. In general, the netting operation occurs as follows.

Purse seining begins with the strike boat holding one end of the net while the large vessel (the seiner) encircles the fish and returns to the strike boat to pick up the other end of the net. At this time, either with or without a tom weight, the vessel begins to draw in the purse line (which is along the leadline) thereby closing the bottom of the net. In mackerel purse seining, the bottom of the net actually is on the sea floor. As the net is pursed or hardened, the floatline is also brought in—although more slowly than the purse line.

Once the purse line is brought in enough to close the bottom of the net, the entire purse line and leadline is brought on board the vessel.

Depending on the water depth, this has probably lifted the net off the bottom and in effect raised the fish more to the surface. The slow retrieval of the floatline has forced the fish into the bunt, which is made of a heavier mesh designed to hold large quantities of fish. When the net is pulled in to the point that the fish are tightly concentrated in the bunt, brailing begins. After the fish have been brailed out of the purse seine, the net then is restacked aboard the vessel (or wound on the drum of a drum-seiner) and readied for the next set.

One of the primary concerns of the management councils was whether or not fish that had been encircled could be released unharmed if the fishermen decided they were not wanted (for whatever reason). This is especially crucial in the case of mackerels because they are extremely delicate fishes. It has been documented in Pawson and Lockwood (1980) and Lockwood, Pawson and Eaton (1983) that another scombrid (Scomber scombrus) is subject to very high mortality rates after being "dried up" and then "slipped" or released from a purse seine. There is a major difference, however, in releasing fish when they are first clearly visible and still swimming in the net (as the observers in our project reported) and releasing fish after being "dried up" (as the preceding authors described).

The observers believe that if fish are released at the point at which they are first clearly seen in the net, chances of survival are 90% or more. Many factors, such as the quantity of fish, species behavior, water clarity and depth, etc. affect the point at which fish can first be seen, but observers report that when mackerel are visible enough to identify species and approximate size, they are still swimming and have not come in contact with the net. This is the point at which they would be released if they were unwanted, not after the net was "dried up". When the fish are seen, the operations from the release of the strike boat in the water to the commencement of brailing is from 70 to 85% completed. The diameter of the area encompassed by the float line at this point is about 25 to 50 feet.

From March 1983 through March 1986, observers were placed on 305 purse seine trips (departure from a port and return to a port by a vessel is considered a trip; a trip may last one day or several days). Of those 305 trips (Table 1), 252 were in the Atlantic and 53 in the Gulf of Mexico. King mackerel were caught on only 22 (all in the Atlantic) of those trips. Spanish mackerel were caught on only 30 (23 in the Atlantic, 7 in the Gulf) of those trips. As is evident, 83% of the trips were made in the Atlantic.

During the three-year period, 33 persons served as observers. Only 13 of the 33 observed king mackerel catches and only 17 of the 33 observed Spanish mackerel catches. Of the 22 king mackerel catches, seven persons observed only one catch, four observed two catches, one observed three catches, and one observed four catches. Of the 30 Spanish mackerel catches, eleven observed one catch, three observed two catches, two observed three catches, and one observed seven catches.

The landings have never equalled the annual quota allotted to the purse seiners. Even the aggregate landings for the entire period from March 1983 through March 1986 have not equalled the first year's king mackerel quota. The data on king mackerel (Gulf Migratory Group) and Spanish mackerel shown in Tables 2 and 3 indicate the percentages of the total commercial catches that purse seining took. For each species in this three-year period, purse seining accounted for less than 3% of the commercial landings.

Although mackerel landings have been low, purse seine vessel operators have demonstrated their ability to identify fish schools correctly prior to making a set. Of 267 observed seine sets, the primary species in the catch was correctly identified 231 times (86%) before the net was deployed. In 13 cases (5%) the observer recorded no particular anticipated catch by the vessel operator, and in 23 cases (9%) the species in the catch was misidentified prior to the set.

SPECIES COMPOSITION

Clean catches, that is, when by-catches of other species were negligible, were more frequent in king mackerel catches than in Spanish mackerel catches (Tables 4 and 5). (Negligible is here defined as less than five percent of the total poundage in a set of the purse seine.) Sixteen of the 22 catches of king mackerel were clean, and fifteen of the 30 catches of Spanish mackerel were clean. Spanish mackerel was a by-catch (not the most abundant species in the set) in seven of the 30 catches, whereas king mackerel was so in only four instances. In three instances, king mackerel was a by-catch in Spanish mackerel catches. Mackerels were caught simultaneously in various mixtures and in appreciable amounts with at least eleven other species (Tables 4 and 5).

Often times, large catches with no mackerels were made by purse seiners. Sixty-four trips yielded no mackerels but still produced 3,146,865 lbs of fishes (Table 6).

SIZE COMPOSITION

Mean fork lengths of king mackerel ranged from 425.0 mm to 1,143.8 mm in the purse seine catches (Table 7). Individual fork lengths ranged from 370 mm to 1,550 mm. Of the fish measured in the twenty-four sets, one group had its mode at 450 (mid-point of 100 mm classes), one had its mode at 550, five had modes at 650, four at 750, five at 850, six at 950, one at 1,050, and one at 1,150 (Table 8). The data from Table 8 were combined into an overall length-frequency distribution of purse seined king mackerel which was corrected for the weight of the landings (Table 9 and Figure 1). The correction for weight was made so that data from small landings when combined with data from large landings would not distort the overall length frequency distribution.

The adjustments for the weight of landings were done as follows: the percentage of the total weight of landings (by species) that each catch from Tables 8 and 12 made up, was calculated (e.g., the 3,350 lb catch of Spanish mackerel shown at the top of Table 12 was 0.62% of the 537,185 lb total catch). The percentage of each individual length frequency size class within a catch was multiplied by the percentage of the weight of that catch in the total (e.g., 41.00% of the 3,350 lb catch was in the 325 mm mid-point size class and its percentage of the whole was $41.00\% \times 0.62\%$, or 0.25%). Finally, the percentages of all similar size classes in all catches were added together and presented in Tables 9 and 13.

These data indicate that almost equal amounts of king mackerel were landed in both the 750, 850, and 950 mm FL midpoint groups. About 75% of all fish were between 600 and 1,000 mm FL; fish of these sizes range in weight from four to 18 pounds and are from two to nine years old, depending on their sex. The smallest measured fish (370 mm FL) was probably in its first year, while the largest measured fish (1,550 mm FL) was probably over 12 years old. When the purse seine length data are compared to historical landings data from other fishing gear (Table 10), it is apparent that larger king mackerel make up a higher percentage of purse seine catches than of any other gear.

Mean lengths of Spanish mackerel ranged from 322.7 to 576.2 mm FL (Table 11). Two catches had modes at 625 (midpoint of 50 mm classes), one at 525, two at 475, thirteen at 425, eight at 375, and two at 325 mm (Table 12). When all the Spanish mackerel catches were combined and corrected for the weight of landings (Table 13), about 59% of all the mackerel measured between 350 and 450 mm FL (Figure 2). About 90% of all fish were between 300 and 550 mm FL; these fish weighed from a half pound to three pounds. The smallest measured Spanish mackerel was 260 mm FL. This fish weighed approximately one-third of a pound and was probably less than one year old. The largest fish was 745 mm FL, approximately six pounds, and seven to eight years old.

King mackerel attain sexual maturity between 700 and 900 mm FL, depending upon sex, whereas both sexes of Spanish mackerel attain sexual maturity between 350 and 400 mm FL. Thus, about 20% of the purse-seined king mackerel and about 10% of the purse-seined Spanish mackerel were sexually immature.

In an effort to estimate the numbers of mackerels landed in purse seine catches, mean fork lengths and poundage from each catch were converted, using length-weight equations, into numbers of fish (Tables 14 and 15). Since March 1983, 23,470 king mackerel and 369,833 Spanish mackerel were estimated to have been taken in purse seine catches.

SEX COMPOSITION

Sex determinations were made on nine king mackerel catches (= schools) and thirteen Spanish mackerel catches. Chi-square analyses (Simpson et al. 1960) indicated that unequal sex ratios were not uncommon (Table 16). Of the nine king mackerel schools, four sex ratios departed significantly from a one-to-one ratio. Males were more numerous in two schools and females were more numerous in seven. Two of the thirteen Spanish mackerel schools had a sex ratio significantly different from a one-to-one ratio with a preponderance of males (Table 16). No explanation of these divergent sex ratios is readily available.

CONCLUSIONS

1. Catches by purse seines have been less than 3% of the commercial catch of Gulf Migratory Group king mackerel, and less than 3% of the commercial catch of Spanish mackerel.
2. At the point when the size and species of the seined fish can be determined, the observers believe that the fish can be released unharmed. The maximum mortality that may occur at this release point is subjectively estimated to be about ten percent.
3. King mackerel catches, all of which have been made in the Atlantic, most often have little by-catch. When large mixed-species catches are made, king mackerel may be the by-catch rather than the target species. Spanish mackerel occur more often in large mixed-species catches and as by-catches than king mackerel do.
4. King mackerel caught by purse seines included fish of larger sizes than those caught in both the recreational and commercial (both hook-and-line and gill net) catches of southeast Florida.
5. About 20% of king mackerel and about 10% of Spanish mackerel in purse seine catches are likely to be immature fish.
6. Significant differences from 1:1 sex ratios occur in purse-seined mackerel catches.

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Table 1. Summary of data on observed purse seine trips.

Fishing year	No. vessels registered to purse seine	On which observers served	No. trips			No. trips catching mackerel			Catch (pounds)			No. trips catching other spp.			No. trips with no catch
			Atlantic (A)	Gulf (G)	Both	King	Spanish	King	Spanish	Atlantic	Gulf	Atlantic	Gulf	Atlantic	
Mar-Jun '83	18	4	36*	8	44	2(A)	1(A)	20,102(A)	500(A)	8	5	25	3		3
Jul '83-Jun '84	12	7	92**	35	127	11(A)	4(A) 6(G)	134,643(A)	68,366(A) 37,055(G)	15	19	63	10		10
Jul '84-Jun '85	11	4	81***	10	91	7(A)	9(A) 1(G)	56,620(A)	137,994(A) 9,300(G)	9	3	58	6		6
Jul '85-Mar '86	11	1	43***	0	43	2(A)	9(A)	30,819(A)	283,970(A)	5	0	28	0		0
TOTAL			252	53	305	22 1/2	30 1/2	242,184	537,185	37	27	174	19		19

*FL DMR placed observers on 7.5 of these trips (one trip had one DMR observer and one NMFS observer).

**FL DMR placed observers on 19 of these trips.

***FL DMR placed observers on 25 of these trips.

****FL DMR placed observers on 6 of these trips

1/ Four trips caught both king and Spanish mackerel simultaneously.

Table 2. Commercial landings (pounds) of Gulf Migratory Group king mackerel (from E. Snell).

	3/1/83-6/30/83	7/1/83-6/30/84	7/1/84-6/30/85	7/1/85-2/28/86	3/1/83-2/28/86
Hook and line	669,000	1,678,000	1,809,000	1,806,000	5,962,000
Gill net	908,000	1,069,000	968,000	1,185,000	4,130,000
Purse seine	20,102	134,643	56,620	32,486*	243,851
Total commercial	1,597,102	2,881,643	2,833,620	3,023,486	10,335,000
Percentage of total commercial catch by purse seine	1.26%	4.67%	2.00%	1.07%	2.36%
Purse seine quota	400,000	400,000	400,000	284,000	

* Includes 1,667 lbs taken in northern gulf as a by-catch. No observer was present or required since king mackerel were less than 1% of the total catch.

Table 3. Commercial Landings (pounds) of Spanish mackerel (from E. Snell).

	3/1/83- 12/31/83	1984	1985	1/1/86- 2/28/86	3/1/83- 2/28/86
Atlantic total	2,911,000	4,835,000	3,840,000	1,939,000	13,525,000
Purse seine catch	21,250	62,986	189,224	175,370	448,830
Purse seine %	0.73	1.30	4.93	9.04	3.32
Purse seine quota	300,000	300,000	300,000	300,000	
Gulf total	912,000	1,224,000	1,954,000	700,000	4,790,000
Purse seine catch	37,055	9,300	11,567*	0	57,922
Purse seine %	4.06	0.76	0.59	0	1.21
Purse seine quota	300,000	300,000	300,000	300,000	
Overall total	3,823,000	6,059,000	5,794,000	2,639,000	18,315,000
Purse seine catch	58,305	72,286	200,791	175,370	506,752
Purse seine %	1.53	1.19	3.47	6.65	2.77

* Taken in northern gulf as by-catch. No observer was present or required since Spanish mackerel were less than 10% of total catch.

Table 4. Species composition of observed king mackerel catches.

Date of catch	Area of catch	Catch of king mackerel (lbs)	Catch of other species (lbs)
Mar '83	Ft. Pierce	12,057	Negligible
Mar '83	Ft. Pierce	8,045	Negligible
Jan '84	Ft. Pierce	1,880	Negligible
Jan '84	Ft. Pierce	7,120	Negligible
Feb '84	Atlantic side of Keys	1,515	Negligible
Feb '84	Ft. Pierce	7,500	Negligible
Feb '84	Ft. Pierce	16,023	Negligible
Feb '84	Ft. Pierce	9,000	Negligible
Feb '84	Ft. Pierce	28,100	Negligible
Feb '84	Ft. Pierce	15,121	3,500 Blue runner
Mar '84	Ft. Pierce	1,454	4,546 Spanish mackerel
Mar '84	Ft. Pierce	12,500	5,000 Blue runner
Mar '84	Ft. Pierce	34,430	Negligible
Dec '84	Ft. Pierce	170	8,370 Crevalle jack, 7,070 Spanish mackerel, 6,000 Atlantic bumper, and 1,500 Little tunny
Feb '85	Ft. Pierce	280	28,000 Spanish mackerel, 600 Croaker, 550 Seatrout
Mar '85	Ft. Pierce	6,621	Negligible
Mar '85	Ft. Pierce	3,276	Negligible
Mar '85	Ft. Pierce	23,693	Negligible
Mar '85	Ft. Pierce	12,280	Negligible
Mar '85	Ft. Pierce	10,300	Negligible
Jan '86	Ft. Pierce	30,309	Negligible
Feb '86	Ft. Pierce	510	20,378 Spanish mackerel 1,500 Blue runner
TOTAL POUNDS		242,184	87,014

Table 5. Species composition of observed Spanish mackerel catches.

Date of catch	Area of catch	Catch of Spanish mackerel (lbs)	Catch of other species (lbs)
Apr '83	Ft. Pierce	500	80,000 Crevalle jack
Jul '83	Louisiana	3,350	35,000 Red drum, 11,000 Blue runner, 6,000 Little tunny, and 3,300 Crevalle jack
Jul '83	Louisiana	1,500	65,000 Black drum
Jul '83	Louisiana	3,593	20,000 "other fishes"
Nov '83	Gulf side of Keys	16,400	2,500 Atlantic thread herring
Nov '83	Gulf side of Keys	10,893	Negligible
Dec '83	Gulf side of Keys	1,319	Negligible
Dec '83	Ft. Pierce	20,750	Negligible
Jan '84	Ft. Pierce	600	23,000 Blue runner
Mar '84	Ft. Pierce	42,470	Negligible
Mar '84	Ft. Pierce	4,546	1,454 King mackerel
Aug '84	Louisiana	9,300	23,000 Little tunny, 8,000 Crevalle jack, 6,000 Butterfish, and 600 Shark
Dec '84	Ft. Pierce	7,070	8,370 Crevalle jack, 6,000 Atlantic bumper, 1,500 Little tunny, and 170 King mackerel
Dec '84	Ft. Pierce	8,300	1,141 Blue runner
Jan '85	Ft. Pierce	5,800	Negligible
Jan '85	Ft. Pierce	1,500	Negligible
Feb '85	Ft. Pierce	38,100	6,000 Herrings
Feb '85	Ft. Pierce	300	Negligible
Feb '85	Ft. Pierce	28,000	600 Croaker, 550 Seatrout, 280 King mackerel
Feb '85	Ft. Pierce	24,624	Negligible
Mar '85	Ft. Pierce	24,300	Negligible

Table 5. Continued

Date of catch	Area of catch	Catch of Spanish mackerel (lbs)	Catch of other species (lbs)
Dec '85	Ft. Pierce	66,600	Negligible
Jan '86	Ft. Pierce	19,175	Negligible
Jan '86	Ft. Pierce	56,650	Negligible
Feb '86	Ft. Pierce	14,017	Negligible
Feb '86	Ft. Pierce	51,750	Negligible
Feb '86	Ft. Pierce	13,400	1,000 Herrings
Feb '86	Ft. Pierce	20,378	1,500 Blue runner 510 King mackerel
Mar '86	Ft. Pierce	16,500	1,083 Blue runner
Mar '86	Ft. Pierce	25,500	Negligible
TOTAL POUNDS		537,185	312,658

Table 6. Species and quantities (lbs) landed on observed purse seine trips on which no mackerels were landed. Quantities may be actual weights or observers' estimates.

Date of catch	Area of catch	Species and quantities (lbs) landed
Mar '83	Ft. Pierce	Blue runner (4,000)
Mar '83	Ft. Pierce	Blue runner (4,700)
Mar '83	Ft. Pierce	Blue runner (3,400)
Mar '83	Ft. Pierce	Blue runner (2,000)
Mar '83	Ft. Pierce	Blue runner (2,452)
Mar '83	Ft. Pierce	Crevalle jack (68,000)
Mar '83	Ft. Pierce	Crevalle jack (28,000)
Apr '83	Ft. Pierce	Crevalle jack (21,000)
Apr '83	Northern Gulf	Scaled sardine (12,000)
May '83	Northern Gulf	Blue runner (50,000), Little tunny (20,000)
May '83	Northern Gulf	Red drum (75,400), Blue runner (6,500)
Jun '83	Northern Gulf	Blue runner (7,000)
Jun '83	Northern Gulf	Blue runner, Little tunny, Bumper mixed (16,000)
Jul '83	Northern Gulf	Blue runner (4,600), Little tunny (1,400)
Jul '83	Northern Gulf	Bumper (1,500), Thread herring (1,500)
Aug '83	Northern Gulf	Red drum (40,000), Blue runner (3,500), Little tunny (2,000)
Aug '83	Northern Gulf	Red drum (20,000)
Aug '83	Northern Gulf	Red drum (85,000), Blue runner (10,500)
Aug '83	Northern Gulf	Red drum (80,000), Blue runner (32,000)
Aug '83	Northern Gulf	Red drum (60,000), Blue runner (60,000)
Sep '83	Northern Gulf	Black drum (135,000)
Sep '83	Northern Gulf	Black drum (65,000), Red drum (15,000)
Sep '83	Northern Gulf	Blue runner (10,800), Little tunny (3,240)
Sep '83	Northern Gulf	Red drum (111,000), Blue runner (12,500)

Table 6. Continued

Date of catch	Area of catch	Species and quantities (lbs) landed
Sep '83	Northern Gulf	Red drum (50,000), Blue runner (21,500)
Oct '83	Northern Gulf	Black drum (125,000)
Nov '83	Florida Keys	Crevalle jack (33,150)
Dec '83	Northern Gulf	Blue runner (123,000), Little tunny (11,500), Red drum (1,000)
Dec '83	Ft. Pierce	Blue runner (7,000)
Dec '83	Northern Gulf	Blue runner (82,000)
Dec '83	Ft. Pierce	Mullet (20,000)
Dec '83	Ft. Pierce	Crevalle jack (50,000)
Jan '84	Northern Gulf	Black drum (135,000)
Jan '84	Ft. Pierce	Blue runner (91,350)
Feb '84	Florida Keys	Blue runner (1,000)
Feb '84	Ft. Pierce	Crevalle jack (40,000)
Feb '84	Florida Keys	Crevalle jack (11,000)
Feb '84	Ft. Pierce	Crevalle jack (35,673)
Feb '84	Ft. Pierce	Crevalle jack (15,000)
Mar '84	Ft. Pierce	Blue runner (5,000)
Mar '84	Ft. Pierce	Crevalle jack (93,000)
Mar '84	Ft. Pierce	Little tunny (30,000), Blue runner (5,000)
Mar '84	Ft. Pierce	Blue runner (28,000)
Mar '84	Ft. Pierce	Crevalle jack (65,000)
Mar '84	Ft. Pierce	Blue runner (1,000)
Mar '84	Ft. Pierce	Crevalle jack (34,000)
May '84	Northern Gulf	Red drum (100,000), Blue runner (3,500)
Aug '84	Northern Gulf	Black drum (60,000), Red drum (25,000)
Sep '84	Northern Gulf	Little tunny (12,000), Blue runner (6,000)
Dec '84	Northern Gulf	Black drum (125,000), Red drum (14,200)

Table 6. Continued

Date of catch	Area of catch	Species and quantities (lbs) landed
Dec '84	Ft. Pierce	Bigeye scad (35,000)
Jan '85	Ft. Pierce	Crevalle jack (15,000)
Jan '85	Ft. Pierce	Crevalle jack (30,000)
Jan '85	Ft. Pierce	Crevalle jack (70,000)
Feb '85	Ft. Pierce	Blue runner (9,900)
Feb '85	Ft. Pierce	Blue runner (60,000)
Feb '85	Ft. Pierce	Blue runner (35,000)
Feb '85	Ft. Pierce	Blue runner (25,000)
Apr '85	Ft. Pierce	Crevalle jack (55,000)
Dec '86	Ft. Pierce	Crevalle jack (64,300)
Dec '86	Ft. Pierce	Crevalle jack (32,000)
Dec '86	Ft. Pierce	Crevalle jack (75,000)
Dec '86	Ft. Pierce	Crevalle jack (90,000)
Jan '86	Ft. Pierce	Crevalle jack (15,800)
TOTAL		3,146,865 lbs

Table 7. Summary of fork length data on observed king mackerel purse seine catches. All catches made in Atlantic.

Month/Year	Catch (lbs)	Fork length (mm)				
		N	\bar{x}	S.D.	Range	
Mar 1983	8,045	204	777.5	56.9	611- 915	
Mar 1983	12,057	301	748.7	58.5	554-1,215	
Jan 1984	7,120	205	730.0	89.7	606-1,254	
Jan 1984	1,880	177	816.0	74.0	575- 945	
Feb 1984	1,515	192	784.9	85.3	620-1,004	
Feb 1984	7,500	259	687.3	57.0	586- 851	
Feb 1984	16,023	215	712.4	68.0	635- 855	
Feb 1984	9,000	65	786.4	132.8	601-1,072	
Feb 1984	15,121	416	809.7	100.2	595-1,155	
Feb 1984	28,100	485	962.8	102.1	620-1,380	
Mar 1984	1,454	35	688.1	178.4	465-1,090	
Mar 1984	12,500	295	920.2	162.6	585-1,250	
Mar 1984	34,430	453	911.7	110.5	580-1,140	
Dec 1984	170	(Data not available)				
Feb 1985	280	56	425.0	25.2	370- 510	
Mar 1985	6,621	Set 1	54	913.0	51.3	800-1,020
		Set 2	172	811.0	103.4	600-1,120
Mar 1985	3,276	Set 1	13	909.6	102.8	790-1,170
		Set 2	185	991.2	86.8	810-1,270
Mar 1985	23,693	350	781.4	105.5	560-1,005	
Mar 1985	12,280	Set 1	141	892.0	100.9	625-1,110
		Set 2	304	907.6	83.1	700-1,150
Mar 1985	10,300	13	949.7	102.4	740-1,075	
Jan 1986	30,309	211	1,143.8	96.2	850-1,550	
Feb 1986	510	57	539.5	79.5	390-680	
TOTAL CATCH	242,184	4,858			370-1,550	

Table 8. Length-frequency tables of purse-seined king mackerel. The tables represent the catches in the same sequence shown in Table 7.

8,045 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
601.00 < 701.00	10	4.90	10	4.90
701.00 < 801.00	133	65.20	143	70.10
801.00 < 901.00	58	28.43	201	98.53
901.00 < 1001.00	3	1.47	204	100.00
Total	204	100.00		

12,057 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
501.00 < 601.00	3	1.00	3	1.00
601.00 < 701.00	36	11.96	39	12.96
701.00 < 801.00	231	76.74	270	89.70
801.00 < 901.00	30	9.97	300	99.67
1201.00 < 1301.00	1	.33	301	100.00
Total	301	100.00		

7,120 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
601.00 < 701.00	90	43.90	90	43.90
701.00 < 801.00	80	39.02	170	82.93
801.00 < 901.00	26	12.68	196	95.61
901.00 < 1001.00	8	3.90	204	99.51
1201.00 < 1301.00	1	.49	205	100.00
Total	205	100.00		

Table 8. Continued

-----1,880 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
501.00 < 601.00	1	.56	1	.56
601.00 < 701.00	11	6.21	12	6.78
701.00 < 801.00	51	28.81	63	35.59
801.00 < 901.00	100	56.50	163	92.09
901.00 < 1001.00	14	7.91	177	100.00
Total	177	100.00		

-----1,515 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
601.00 < 701.00	28	14.58	28	14.58
701.00 < 801.00	90	46.88	118	61.46
801.00 < 901.00	56	29.17	174	90.63
901.00 < 1001.00	17	8.85	191	99.48
1001.00 < 1101.00	1	.52	192	100.00
Total	192	100.00		

-----7,500 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
501.00 < 601.00	8	3.09	8	3.09
601.00 < 701.00	153	59.07	161	62.16
701.00 < 801.00	94	36.29	255	98.46
801.00 < 901.00	4	1.54	259	100.00
Total	259	100.00		

-----16,023 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
601.00 < 701.00	107	49.77	107	49.77
701.00 < 801.00	84	39.07	191	88.84
801.00 < 901.00	24	11.16	215	100.00
Total	215	100.00		

Table 8. Continued.

9,000 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
501.00 < 601.00	2	3.08	2	3.08
601.00 < 701.00	19	29.23	21	32.31
701.00 < 801.00	17	26.15	38	58.46
801.00 < 901.00	13	20.00	51	78.46
901.00 < 1001.00	9	13.85	60	92.31
1001.00 < 1101.00	5	7.69	65	100.00
Total	65	100.00		

15,121 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
501.00 < 601.00	2	.48	2	.48
601.00 < 701.00	57	13.70	59	14.18
701.00 < 801.00	135	32.45	194	46.63
801.00 < 901.00	150	36.06	344	82.69
901.00 < 1001.00	62	14.90	406	97.60
1001.00 < 1101.00	9	2.16	415	99.76
1101.00 < 1201.00	1	.24	416	100.00
Total	416	100.00		

28,100 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
601.00 < 701.00	1	.21	1	.21
701.00 < 801.00	14	2.89	15	3.09
801.00 < 901.00	118	24.33	133	27.42
901.00 < 1001.00	196	40.41	329	67.84
1001.00 < 1101.00	116	23.92	445	91.75
1101.00 < 1201.00	31	6.39	476	98.14
1201.00 < 1301.00	8	1.65	484	99.79
1301.00 < 1401.00	1	.21	485	100.00
Total	485	100.00		

Table 8. Continued.

-----1,454 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
401.00 < 501.00	6	17.14	6	17.14
501.00 < 601.00	4	11.43	10	28.57
601.00 < 701.00	14	40.00	24	68.57
701.00 < 801.00	2	5.71	26	74.29
801.00 < 901.00	1	2.86	27	77.14
901.00 < 1001.00	7	20.00	34	97.14
1001.00 < 1101.00	1	2.86	35	100.00
Total	35	100.00		

-----12,500 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
501.00 < 601.00	7	2.37	7	2.37
601.00 < 701.00	42	14.24	49	16.61
701.00 < 801.00	21	7.12	70	23.73
801.00 < 901.00	28	9.49	98	33.22
901.00 < 1001.00	96	32.54	194	65.76
1001.00 < 1101.00	72	24.41	266	90.17
1101.00 < 1201.00	26	8.81	292	98.98
1201.00 < 1301.00	3	1.02	295	100.00
Total	295	100.00		

-----34,430 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
501.00 < 601.00	6	1.32	6	1.32
601.00 < 701.00	25	5.52	31	6.84
701.00 < 801.00	28	6.18	59	13.02
801.00 < 901.00	103	22.74	162	35.76
901.00 < 1001.00	214	47.24	376	83.00
1001.00 < 1101.00	74	16.34	450	99.34
1101.00 < 1201.00	3	.66	453	100.00
Total	453	100.00		

Table 8. Continued.

-----280 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 401.00	6	10.71	6	10.71
401.00 < 501.00	49	87.50	55	98.21
501.00 < 601.00	1	1.79	56	100.00
Total	56	100.00		

-----Set 1 of 6,621 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
801.00 < 901.00	23	42.59	23	42.59
901.00 < 1001.00	28	51.86	51	94.44
1001.00 < 1101.00	3	5.56	54	100.00
Total	54	100.00		

-----Set 2 of 6,621 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
601.00 < 701.00	22	12.79	22	12.79
701.00 < 801.00	65	37.79	87	50.58
801.00 < 901.00	52	30.24	139	80.81
901.00 < 1001.00	26	15.12	165	95.93
1001.00 < 1101.00	4	2.33	169	98.26
1101.00 < 1201.00	3	1.74	172	100.00
Total	172	100.00		

-----Set 1 of 3,276 catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
701.00 < 801.00	1	7.69	1	7.69
801.00 < 901.00	7	53.84	8	61.54
901.00 < 1001.00	3	23.07	11	84.62
1001.00 < 1101.00	1	7.69	12	92.31
1101.00 < 1201.00	1	7.69	13	100.00
Total	13	100.00		

Table 8. Continued.

Set 2 of 3,276 lb catch				
Class Limits	Frequency	Percent	Cumulative Frequency	Cumulative Percent
801.00 < 901.00	21	11.35	21	11.35
901.00 < 1001.00	91	49.19	112	60.54
1001.00 < 1101.00	53	28.65	165	89.19
1101.00 < 1201.00	15	8.11	180	97.30
1201.00 < 1301.00	5	2.70	185	100.00
Total	185	100.00		

23,693 lb catch				
Class Limits	Frequency	Percent	Cumulative Frequency	Cumulative Percent
501.00 < 601.00	18	5.14	18	5.14
601.00 < 701.00	61	17.43	79	22.57
701.00 < 801.00	108	30.86	187	53.43
801.00 < 901.00	117	33.43	304	86.86
901.00 < 1001.00	44	12.57	348	99.43
1001.00 < 1101.00	2	.57	350	100.00
Total	350	100.00		

Set 1 of 12,280 lb catch				
Class Limits	Frequency	Percent	Cumulative Frequency	Cumulative Percent
601.00 < 701.00	3	2.13	3	2.13
701.00 < 801.00	25	17.73	28	19.86
801.00 < 901.00	50	35.46	78	55.32
901.00 < 1001.00	37	26.24	115	81.56
1001.00 < 1101.00	25	17.73	140	99.29
1101.00 < 1201.00	1	.71	141	100.00
Total	141	100.00		

Table 8. Continued

-----Set 2 of 12,280 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
701.00 < 801.00	33	10.86	33	10.86
801.00 < 901.00	102	33.55	135	44.41
901.00 < 1001.00	129	42.43	264	86.84
1001.00 < 1101.00	38	12.50	302	99.34
1101.00 < 1201.00	2	.66	304	100.00
Total	304	100.00		

-----10,300 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
701.00 < 801.00	2	15.38	2	15.38
801.00 < 901.00	2	15.38	4	30.76
901.00 < 1001.00	4	30.77	8	61.53
1001.00 < 1101.00	5	38.46	13	100.00
Total	13	100.00		

-----30,309 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
801.00 < 901.00	1	.47	1	.47
901.00 < 1001.00	11	5.21	12	5.68
1001.00 < 1101.00	51	24.17	63	29.85
1101.00 < 1201.00	95	45.02	158	74.87
1201.00 < 1301.00	46	21.80	204	96.67
1301.00 < 1401.00	5	2.37	209	99.04
1401.00 < 1501.00	1	.47	210	99.51
1501.00 < 1601.00	1	.47	211	100.00
Total	211	100.00		

-----510 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
301.00 < 401.00	2	3.51	2	3.51
401.00 < 501.00	15	26.32	17	29.83
501.00 < 601.00	27	47.37	44	77.20
601.00 < 701.00	13	22.81	57	100.00
Total	57	100.00		

Table 9. Length frequency distribution of purse seined king mackerel (adjusted for weight of landings).

Fork length midpoint	Percentage
350	0.02
450	0.27
550	1.28
650	13.12
750	21.29
850	19.57
950	21.13
1050	12.73
1150	7.12
1250	3.03
1350	0.32
1450	0.06
1550	0.06

Table 10. King mackerel length frequency distributions by various gear types. Purse seine catches are adjusted for weight of landings. Other data from Trent, Godcharles, Palko, Collins, and Trimble (manuscript in preparation).

Fork length midpoint (mm)	Purse seine	Commercial hook and line	Gill net	Headboat	Recreational hook and line
350	0.02		0.55	0.35	0.31
450	0.27		0.72	1.73	2.20
550	1.28	2.91	0.09	9.34	12.44
650	13.12	25.74	10.24	24.22	22.05
750	21.29	44.05	47.67	23.94	24.25
850	19.57	20.19	30.26	24.65	20.58
950	21.13	5.39	7.39	11.11	12.44
1050	12.73	1.25	2.31	3.61	4.67
1150	7.12	0.28	0.61	0.71	1.00
1250	3.03	0.10	0.15	0.20	0.06
1350	0.32		0.02	0.04	
1450	0.06			0.08	
1550	0.06				
1650				0.04	

Table 11. Summary of fork length data on observed Spanish mackerel purse seine catches.

Month/Year	(lbs)	Fork length (mm)				Area
		N	\bar{x}	S.D.	Range	
Apr 1983	500	(Data not available)				Atlantic
Jul 1983	3,350	400	362.6	40.4	300-560	Gulf
Jul 1983	1,500	259	364.6	31.1	306-458	Gulf
Jul 1983	3,593	400	363.6	30.7	260-450	Gulf
Nov 1983	16,400	432	439.3	44.6	355-570	Gulf
Nov 1983	10,893	405	422.8	35.0	327-545	Gulf
Dec 1983	1,319	100	432.5	34.6	362-510	Gulf
Dec 1983	20,750	437	400.3	40.9	320-570	Atlantic
Jan 1984	600	107	322.7	29.4	272-386	Atlantic
Mar 1984	42,470	338	412.5	32.5	355-525	Atlantic
Mar 1984	4,546	238	452.5	42.5	390-625	Atlantic
Aug 1984	9,300	(Data not available)				Gulf
Dec 1984	7,070	199	443.3	71.9	326-726	Atlantic
Dec 1984	8,300	208	437.8	42.8	326-526	Atlantic
Jan 1985	5,800	(Data not available)				Atlantic
Jan 1985	1,500	197	425.2	50.1	323-573	Atlantic
Feb 1985	38,100	360	386.9	33.2	303-538	Atlantic
Feb 1985	300	100	363.5	24.4	313-438	Atlantic
Feb 1985	28,000	496	416.2	40.7	330-640	Atlantic
Feb 1985	24,624	Set 1 210	365.0	40.9	310-480	Atlantic
		Set 2 237	367.0	38.2	290-490	Atlantic
Mar 1985	24,300	343	394.7	33.3	310-500	Atlantic
Dec 1985	66,600	198	523.0	43.3	430-630	Atlantic
Jan 1986	19,175	208	576.2	92.1	370-740	Atlantic
Jan 1986	56,650	232	465.3	77.2	330-720	Atlantic

Table 11. Continued

Month/Year	(lbs)	Fork length (mm)				Area
		N	\bar{x}	S.D.	Range	
Feb 1986	14,017	204	506.2	51.3	360-630	Atlantic
Feb 1986	51,750	458	405.6	35.7	330-500	Atlantic
Feb 1986	13,400	209	476.0	63.0	320-630	Atlantic
Feb 1986	20,378	206	411.6	45.6	330-570	Atlantic
Mar 1986	16,500	214	575.0	73.0	420-740	Atlantic
Mar 1986	25,500	211	425.7	50.2	340-630	Atlantic
TOTAL CATCH	537,185	7,606			260-740	

Table 12. Length-frequency tables of purse-seined Spanish mackerel. The tables represent the catches in the same sequence shown in Table 11.

-----3,350 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
251.00 < 301.00	1	.25	1	.25
301.00 < 351.00	164	41.00	165	41.25
351.00 < 401.00	197	49.25	362	90.50
401.00 < 451.00	25	6.25	387	96.75
451.00 < 501.00	7	1.75	394	98.50
501.00 < 551.00	4	1.00	398	99.50
551.00 < 601.00	2	.50	500	100.00
Total	400	100.00		

-----1,500 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 351.00	84	32.43	84	32.43
351.00 < 401.00	152	58.69	236	91.12
401.00 < 451.00	21	8.11	257	99.23
451.00 < 501.00	2	.77	259	100.00
Total	259	100.00		

-----3,593 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
251.00 < 301.00	8	2.00	8	2.00
301.00 < 351.00	113	28.25	121	30.25
351.00 < 401.00	249	62.25	370	92.50
401.00 < 451.00	30	7.50	400	100.00
Total	400	100.00		

Table 12. Continued.

-----16,400 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
351.00 < 401.00	78	18.06	78	18.06
401.00 < 451.00	204	47.22	282	65.28
451.00 < 501.00	115	26.62	397	91.90
501.00 < 551.00	27	6.25	424	98.15
551.00 < 601.00	8	1.85	432	100.00
Total	432	100.00		

-----10,893 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 351.00	3	.74	3	.74
351.00 < 401.00	99	24.44	102	25.19
401.00 < 451.00	229	56.54	331	81.73
451.00 < 501.00	69	17.04	400	98.77
501.00 < 551.00	5	1.23	405	100.00
Total	405	100.00		

-----1,319 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
351.00 < 401.00	16	16.00	16	16.00
401.00 < 451.00	57	57.00	73	73.00
451.00 < 501.00	25	25.00	98	98.00
501.00 < 551.00	2	2.00	100	100.00
Total	100	100.00		

Table 12. Continued.

-----20,750 lb catch-----					
-----Class Limits-----		Frequency	Percent	-----Cumulative-----	
				Frequency	Percent
301.00 <	351.00	26	5.95	26	5.95
351.00 <	401.00	223	51.03	249	56.98
401.00 <	451.00	148	33.87	397	90.85
451.00 <	501.00	32	7.32	429	98.17
501.00 <	551.00	5	1.14	434	99.31
551.00 <	601.00	3	.69	437	100.00
Total		437	100.00		

600 lb catch					
Class Limits		Frequency	Percent	Cumulative	
				Frequency	Percent
251.00 <	301.00	22	20.56	22	20.56
301.00 <	351.00	70	65.42	92	85.98
351.00 <	401.00	15	14.02	107	100.00
Total		107	100.00		

42,470 lb catch					
Class Limits		Frequency	Percent	Cumulative	
				Frequency	Percent
351.00 <	401.00	126	37.28	126	37.28
401.00 <	451.00	180	53.25	306	90.53
451.00 <	501.00	29	8.58	335	99.11
501.00 <	551.00	3	.89	338	100.00
Total		338	100.00		

Table 12. Continued.

-----4,546 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
351.00 < 401.00	10	4.20	10	4.20
401.00 < 451.00	126	52.94	136	57.14
451.00 < 501.00	77	32.35	213	89.50
501.00 < 551.00	19	7.98	232	97.48
551.00 < 601.00	3	1.26	235	98.74
601.00 < 651.00	3	1.26	238	100.00
Total	238	100.00		

-----7,070 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 351.00	3	1.51	3	1.51
351.00 < 401.00	60	30.15	63	31.66
401.00 < 451.00	69	34.67	132	66.33
451.00 < 501.00	28	14.07	160	80.40
501.00 < 551.00	21	10.55	181	90.95
551.00 < 601.00	11	5.53	192	96.48
601.00 < 651.00	4	2.01	196	98.49
651.00 < 701.00	2	1.01	198	99.50
701.00 < 751.00	1	.50	199	100.00
Total	199	100.00		

-----8,300 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 351.00	1	.48	1	.48
351.00 < 401.00	37	17.79	38	18.27
401.00 < 451.00	99	47.60	137	65.87
451.00 < 501.00	54	25.96	191	91.83
501.00 < 551.00	17	8.17	208	100.00
Total	208	100.00		

Table 12. Continued.

1,500 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	4	2.03	4	2.03
351.00 < 401.00	58	29.44	62	31.47
401.00 < 451.00	78	39.60	140	71.07
451.00 < 501.00	41	20.81	181	91.88
501.00 < 551.00	13	6.61	194	98.48
551.00 < 601.00	3	1.52	197	100.00
Total	197	100.00		

38,100 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	47	13.06	47	13.06
351.00 < 401.00	195	54.16	242	67.22
401.00 < 451.00	104	28.89	346	96.11
451.00 < 501.00	13	3.61	359	99.72
501.00 < 551.00	1	.28	360	100.00
Total	360	100.00		

300 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	29	29.00	29	29.00
351.00 < 401.00	65	65.00	94	94.00
401.00 < 451.00	6	6.00	100	100.00
Total	100	100.00		

Table 12. Continued.

28,000 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	10	2.02	10	2.02
351.00 < 401.00	159	32.06	169	34.07
401.00 < 451.00	255	51.41	424	85.48
451.00 < 501.00	56	11.29	480	96.77
501.00 < 551.00	14	2.82	494	99.60
601.00 < 651.00	2	.40	496	100.00
Total	496	100.00		

Set 1 of 24,624 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	91	43.33	91	43.33
351.00 < 401.00	74	35.24	165	78.57
401.00 < 451.00	41	19.52	206	98.10
451.00 < 501.00	4	1.90	210	100.00
Total	210	100.00		

Set 2 of 24,624 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
251.00 < 301.00	1	.42	1	.42
301.00 < 351.00	84	35.44	85	35.86
351.00 < 401.00	108	45.57	193	81.43
401.00 < 451.00	40	16.88	233	98.31
451.00 < 501.00	4	1.69	237	100.00
Total	237	100.00		

24,300 lb catch				
Class Limits	Frequency	Percent	Cumulative	
			Frequency	Percent
301.00 < 351.00	23	6.71	23	6.71
351.00 < 401.00	174	50.73	197	57.43
401.00 < 451.00	134	39.07	331	96.50
451.00 < 501.00	12	3.50	343	100.00
Total	343	100.00		

Table 12. Continued

-----66,600 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
401.00 < 451.00	2	1.01	2	1.01
451.00 < 501.00	64	32.32	66	33.33
501.00 < 551.00	80	40.40	146	73.73
551.00 < 601.00	44	22.22	190	95.95
601.00 < 651.00	8	4.04	198	100.00
Total	198	100.00		

-----19,175 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
351.00 < 401.00	5	2.40	5	2.40
401.00 < 451.00	17	8.17	22	10.57
451.00 < 501.00	36	17.31	58	27.88
501.00 < 551.00	22	10.58	80	38.46
551.00 < 601.00	19	9.13	99	47.59
601.00 < 651.00	54	25.96	153	73.55
651.00 < 701.00	49	23.55	202	97.10
701.00 < 751.00	6	2.88	208	100.00
Total	208	100.00		

-----56,650 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
301.00 < 351.00	3	1.29	3	1.29
351.00 < 401.00	35	15.09	38	16.38
401.00 < 451.00	88	37.93	126	54.31
451.00 < 501.00	47	20.26	173	74.57
501.00 < 551.00	19	8.19	192	82.76
551.00 < 601.00	21	9.05	213	91.81
601.00 < 651.00	16	6.90	229	98.71
651.00 < 701.00	2	0.86	231	99.57
701.00 < 751.00	1	0.43	232	100.00
Total	232	100.00		

-----14,017 lb catch-----				
-----Class Limits-----	Frequency	Percent	-----Cumulative----- Frequency	Percent
351.00 < 401.00	4	1.96	4	1.96
401.00 < 451.00	18	8.82	22	10.78
451.00 < 501.00	76	37.25	98	48.03
501.00 < 551.00	65	31.86	163	79.89
551.00 < 601.00	35	17.16	198	97.05
601.00 < 651.00	6	2.94	204	100.00
Total	204	100.00		

Table 12. Continued

-----51,750 lb catch-----				
----Class Limits----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
301.00 < 351.00	15	3.28	15	3.28
351.00 < 401.00	192	41.92	207	45.20
401.00 < 451.00	210	45.85	417	91.05
451.00 < 501.00	38	8.30	455	99.35
501.00 < 551.00	3	0.66	458	100.00
Total	458	100.00		

-----13,400 lb catch-----				
----Class Limits----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
301.00 < 351.00	3	1.44	3	1.44
351.00 < 401.00	16	7.66	19	9.10
401.00 < 451.00	58	27.75	77	36.85
451.00 < 501.00	62	29.67	139	66.52
501.00 < 551.00	43	20.57	182	87.09
551.00 < 601.00	21	10.05	203	97.14
601.00 < 651.00	6	2.87	209	100.00
Total	209	100.00		

-----20,378 lb catch-----				
----Class Limits----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
301.00 < 351.00	12	5.83	12	5.83
351.00 < 401.00	73	35.44	85	41.27
401.00 < 451.00	88	42.72	173	83.99
451.00 < 501.00	26	12.62	199	96.61
501.00 < 551.00	5	2.43	204	99.04
551.00 < 601.00	2	0.97	206	100.00
Total	206	100.00		

-----16,500 lb catch-----				
----Class Limits----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
401.00 < 451.00	14	6.54	14	6.54
451.00 < 501.00	25	11.68	39	18.22
501.00 < 551.00	31	14.49	70	32.71
551.00 < 601.00	55	25.70	125	58.41
601.00 < 651.00	58	27.10	183	85.51
651.00 < 701.00	28	13.08	211	98.59
701.00 < 751.00	3	1.40	214	100.00
Total	214	100.00		

Table 12. Continued

-----25,500 lb catch-----				
----Class Limits----	Frequency	Percent	-----Cumulative-----	
			Frequency	Percent
301.00 < 351.00	6	2.84	6	2.84
351.00 < 401.00	56	26.54	62	29.38
401.00 < 451.00	100	47.39	162	76.77
451.00 < 501.00	31	14.69	193	91.46
501.00 < 551.00	13	6.16	206	97.62
551.00 < 601.00	4	1.90	210	99.52
601.00 < 651.00	1	0.47	211	100.00
Total	211	100.00		

Table 13. Length frequency distribution of purse seined Spanish mackerel (adjusted for weight of landings).

Fork length midpoint	Percentage
275	0.04
325	5.07
375	26.68
425	32.22
475	15.48
525	9.61
575	6.01
625	3.31
675	1.38
725	0.20

Table 14. Estimated numbers of king mackerel landed from observed purse seine catches. Calculations based on mean fork lengths and length-weight relationship where $W = \text{weight (gm)}$, $L = \text{length (mm FL)}$, $W = 0.8464 \times 10^{-5} FL^{2.9881}$ (formula in Johnson, Fable, Williams, and Barger, 1983).

Month/Year	Location	Catch (lbs)	\bar{x} FL	Number of fish
Mar 1983	Ft. Pierce	8,045	777.5	993
Mar 1983	Ft. Pierce	12,057	748.7	1,668
Jan 1984	Ft. Pierce	7,120	730.0	1,061
Jan 1984	Ft. Pierce	1,880	816.0	201
Feb 1984	Atlantic side of Keys	1,515	784.9	182 (calc.) 192 (actual)
Feb 1984	Ft. Pierce	7,500	687.3	1,339
Feb 1984	Ft. Pierce	16,023	712.4	2,572
Feb 1984	Ft. Pierce	9,000	786.4	1,074
Feb 1984	Ft. Pierce	15,121	809.7	1,654
Feb 1984	Ft. Pierce	28,100	962.8	1,833
Mar 1984	Ft. Pierce	1,454	688.1	259
Mar 1984	Ft. Pierce	12,500	920.2	934
Mar 1984	Ft. Pierce	34,430	911.7	2,642
Dec 1984	Ft. Pierce	170	--	20 (est.)
Feb 1985	Ft. Pierce	280	425.0	211
Mar 1985	Ft. Pierce	6,621	{ 913.0 811.0	76* 610*
Mar 1985	Ft. Pierce	3,276	{ 909.6 991.2	13 (actual) 186
Mar 1985	Ft. Pierce	23,693	781.4	2,882
Mar 1985	Ft. Pierce	12,280	{ 892.0 907.6	503* 478*
Mar 1985	Ft. Pierce	10,300	949.7	700

Table 14. Continued

Month/Year	Location	Catch (lbs)	\bar{x} FL	Number of fish
Jan 1986	Ft. Pierce	30,309	1,143.8	1,181
Feb 1986	Ft. Pierce	510	539.5	<u>188</u>
				23,470 TOTAL

* Indicates numbers estimated from observers' estimates of the proportion of total catch within each set.

Table 15. Estimated numbers of Spanish mackerel landed from observed purse seine catches. Calculations based on mean fork lengths and length-weight relationship where $W = \text{weight (gm)}$, $L = \text{length (mm FL)}$, $W = 9.9632 \times 10^{-6}SL^{3.0076}$ ($SL = 0.9321 \text{ FL} - 2.2619$; formula in Powell, 1975).

Month/Year	Location	Catch (lbs)	\bar{x} FL	Number of fish
Apr 1983	Ft. Pierce	500	--	424 (est.)
Jul 1983	Louisiana	3,350	362.6	3,851
Jul 1983	Louisiana	1,500	364.6	1,705
Jul 1983	Louisiana	3,593	363.6	4,130
Nov 1983	Gulf side of Keys	16,400	439.3	10,581
Nov 1983	Gulf side of Keys	10,893	422.8	7,893
Dec 1983	Gulf side of Keys	1,319	432.5	891
Dec 1983	Ft. Pierce	20,750	400.3	17,735
Jan 1984	Ft. Pierce	600	322.7	984
Mar 1984	Ft. Pierce	42,470	412.5	33,180
Mar 1984	Ft. Pierce	4,546	452.5	2,674
Aug 1984	Louisiana	9,300	--	7,881 (est.)
Dec 1984	Ft. Pierce	7,070	443.3	4,447
Dec 1984	Ft. Pierce	8,300	437.8	5,425
Jan 1985	Ft. Pierce	5,800	--	4,915 (est.)
Jan 1985	Ft. Pierce	1,500	425.2	1,064
Feb 1985	Ft. Pierce	38,100	386.9	35,943
Feb 1985	Ft. Pierce	300	363.5	345
Feb 1985	Ft. Pierce	28,000	416.2	21,212
Feb 1985	Ft. Pierce	24,624	<div style="display: inline-block; vertical-align: middle;"> $\left\{ \begin{array}{l} 365.0 \\ 367.0 \end{array} \right.$ </div>	16,600*
				10,944*
Mar 1985	Ft. Pierce	24,300	394.7	21,696

Table 15. Continued

Month/Year	Location	Catch (lbs)	\bar{x} FL	Number of fish
Dec 1985	Ft. Pierce	66,600	523.0	25,323
Jan 1986	Ft. Pierce	19,175	576.2	5,447
Jan 1986	Ft. Pierce	56,650	465.3	30,622
Feb 1986	Ft. Pierce	14,017	506.2	5,890
Feb 1986	Ft. Pierce	51,750	405.6	42,418
Feb 1986	Ft. Pierce	13,400	476.0	6,768
Feb 1986	Ft. Pierce	20,378	411.6	16,046
Mar 1986	Ft. Pierce	16,500	575.0	4,714
Mar 1986	Ft. Pierce	25,500	425.7	<u>18,085</u>
				369,833 TOTAL

* Indicates numbers estimated from observers' estimates of the proportion of total catch within each set.

Table 16. Chi-square tests of 1:1 sex ratios of mackerels.

Species	Catch date	Number of males	Number of females	Chi-square	Probability
King mackerel	Feb 1984	93	99	0.1875	>0.5<0.7
King mackerel	Feb 1984	149	110	5.8726	>0.01<0.02
King mackerel	Feb 1984	137	78	16.1930	<0.01
King mackerel	Feb 1984	19	85	41.8846	<0.01
King mackerel	Mar 1984	25	175	112.5000	<0.01
King mackerel	Mar 1985	8	13	(1.1904)	>0.2<0.3
King mackerel	Mar 1985	26	31	0.4386	>0.5<0.7
King mackerel	Mar 1985	21	24	0.2000	>0.5<0.7
King mackerel	Jan 1986	1	5	(2.6667)	>0.1<0.2
Spanish mackerel	Nov 1983	46	23	7.6667	<0.01
Spanish mackerel	Mar 1984	50	46	1.6667	>0.1<0.2
Spanish mackerel	Feb 1985	16	12	(0.5714)	>0.3<0.5
Spanish mackerel	Feb 1985	13	21	(1.8824)	>0.1<0.2
Spanish mackerel	Feb 1985	32	24	1.1428	>0.2<0.3
Spanish mackerel	Mar 1985	25	12	(4.5676)	>0.02<0.05
Spanish mackerel	Jan 1986	9	15	(1.5000)	>0.2<0.3
Spanish mackerel	Jan 1986	19	20	(0.0256)	>0.8<0.9
Spanish mackerel	Feb 1986	10	10	0	1.0
Spanish mackerel	Feb 1986	26	15	2.9512	>0.05<0.1
Spanish mackerel	Feb 1986	17	10	(1.8148)	>0.1<0.2
Spanish mackerel	Mar 1986	9	15	(1.5000)	>0.2<0.3
Spanish mackerel	Mar 1986	17	15	(0.1250)	>0.7<0.8

Chi-square values in parentheses were determined when the total number of sexed fish was less than 40, and are therefore suspect.

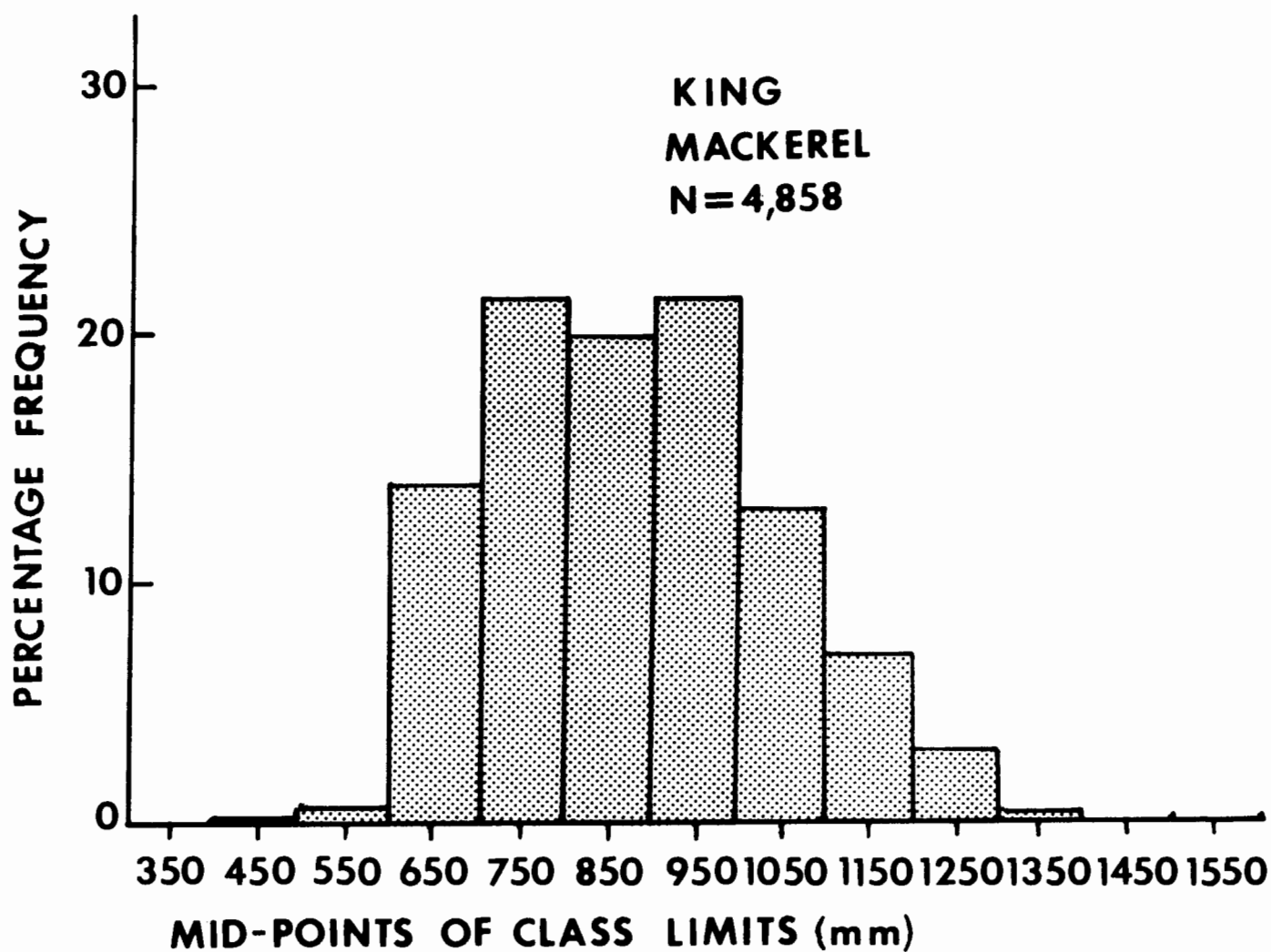


Figure 1. Length-frequency distribution of purse seined king mackerel (adjusted for weight of landings).

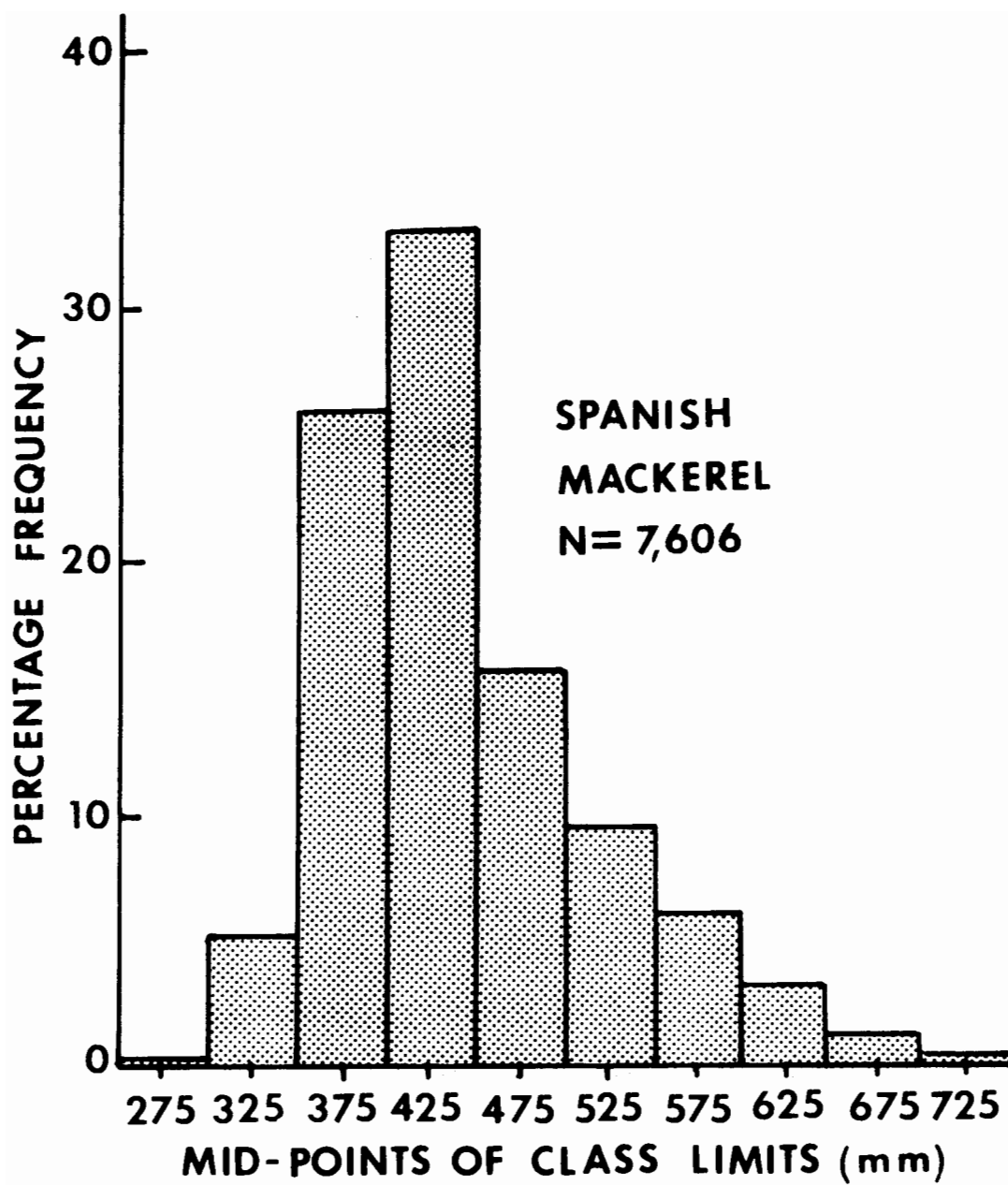


Figure 2. Length-frequency distribution of purse seined Spanish mackerel (adjusted for weight of landings).